Excellent Integrated System Limited

Stocking Distributor

Click to view price, real time Inventory, Delivery & Lifecycle Information:

Toshiba Semiconductor & Storage
TB62755FPG,EL

For any questions, you can email us directly:
sales@integrated-circuit.com

TOSHIBA BiCD Digital Integrated Circuit Silicon Monolithic

TB62755FPG

Step Up Type DC/DC Converter for White LED

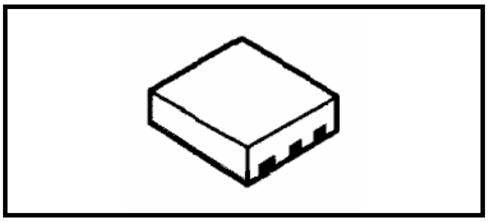
The TB62755FPG is a high efficient Step-Up Type DC/DC Converter specially designed for constant current driving of White LED.

This IC can drive 2-8 white LEDs connected series using a Li-ion battery.

This IC contains N-ch MOS-FET Transistor for Coil-Switching, and LED current (IF) is set with an external resistor.

This IC is especially for driving back light white LEDs in LCD of PDA, Cellular Phone, or Handy Terminal Equipment.

This device is Pb-free product.

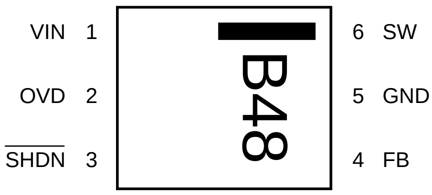


Weight: 0.005 g (typ.)

Features

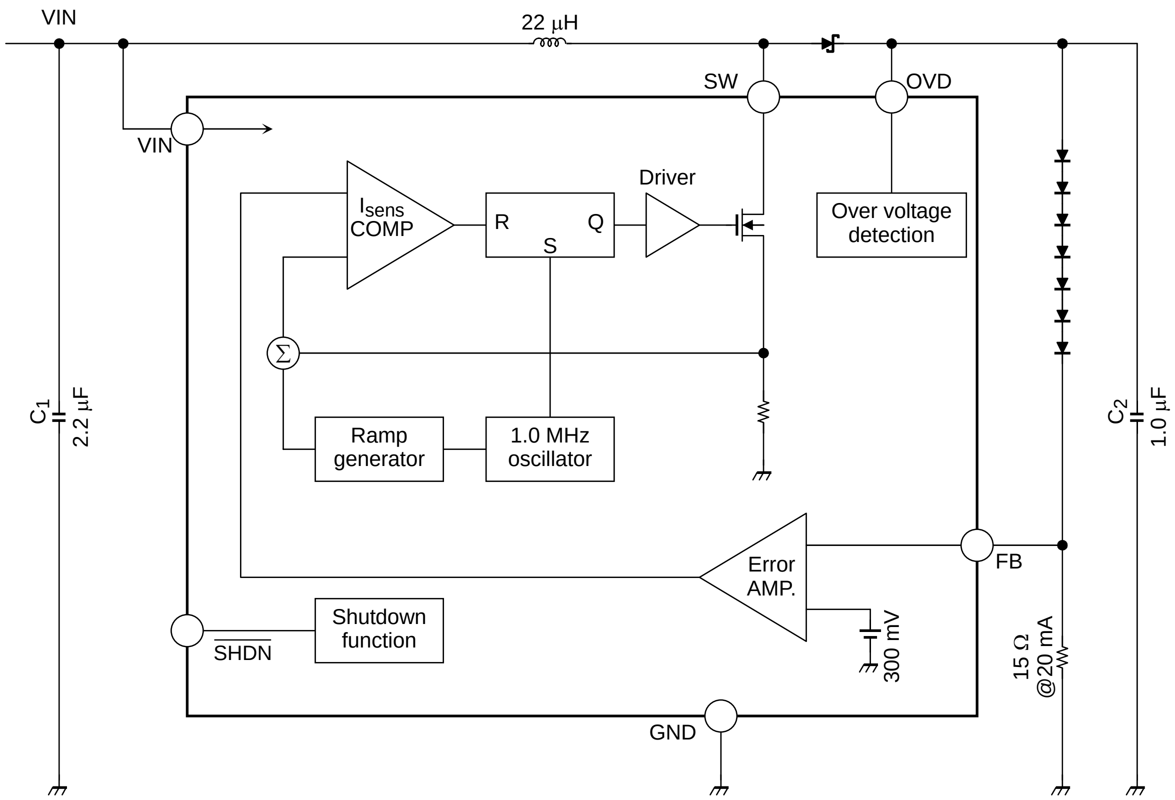
- 2-8 white LEDs connected series (typ. 7LEDs)
- Variable LED current IF is set with a external resistor: 20 mA (typ.) @RSENS = 15 Ω
- Output power: Available for 800 mW LED loading (7LEDs, I_F = Over 25 mA)
- High efficiency: 80% over (using recommended external parts)
- Output over voltage shutdown function
  : Switching operation is shut downed when OVD terminal voltage is over 37 V (typ.).
- IC package: PLP-6
- Switching frequency: 1.0 MHz (typ.)

Pin Assignment (top view)



Note: This IC could be destroyed in some case if amounted in 180° inverse direction.
Please be careful about IC direction in mounting.

Block Diagram

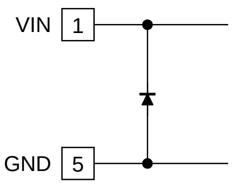


Pin Function

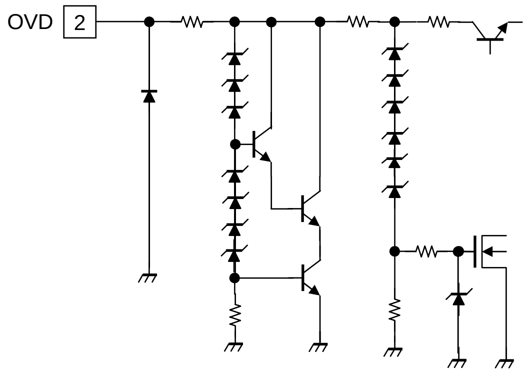
Pin No.	Symbol	Function Description
1	VIN	Supply voltage input terminal. (2.8 V to 5.5 V)
2	OVD	Over voltage detection terminal. IC switching operation is disabled with detection over voltage. If the voltage returns to detection level or less, operation is enabled again.
3	$\overline{\text{SHDN}}$	Voltage-input terminal for IC-enable/disable LED-I_F. A high input on this pin enables the IC to operate while a low input causes it to shut down. The behavior of the IC is unpredictable if the input on the pin is undefined. Ensure that the pin is tied to either a high or low level.
4	FB	LED I_F setting resistor connecting terminal.
5	GND	Ground terminal.
6	SW	Switch terminal for DC/DC converter. Nch MOSFET built-In.

I/O Equivalent Pin Circuits

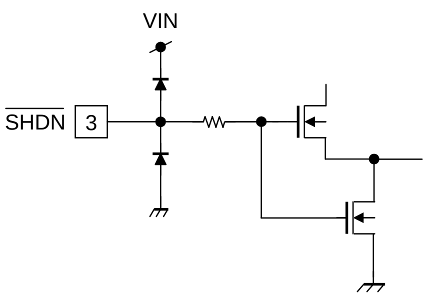
1. **VIN ~ GND**



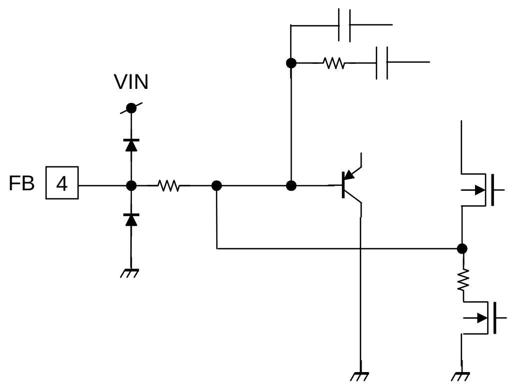
2. **OVD**



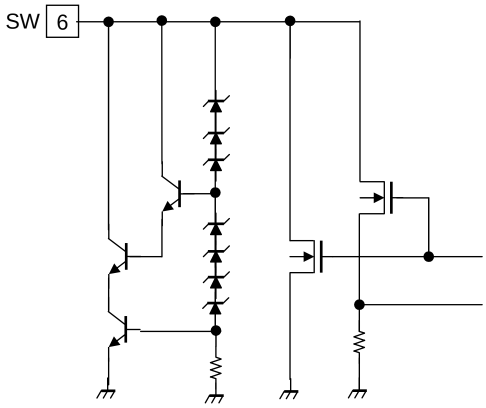
3. **$\overline{\text{SHDN}}$**



4. **FB**



5. **SW**



Absolute Maximum Ratings (Ta = 25°C if without notice)

Characteristics	Symbol	Rating	Unit
Power supply voltage	VIN	−0.3 to + 6.0	V
Input voltage	VIN (SHDN)	−0.3 to +VIN + 0.3 (Note 1)	V
Switching terminal voltage	V_O (SW)	−0.3 to + 40	V
Switching terminal current	I_O (SW)	1500	mA
Power dissipation	P_D	TBD (device)	W
		TBD (on PCB) (Note 2)	
Thermal resistance	$R_{th\ (j-a)}$	TBD (device)	°C/W
		TBD (on PCB)	
Operation temperature range	T_{opr}	−40 to + 85	°C
Storage temperature range	T_{stg}	−55 to + 150	°C
Maximum junction temperature	T_j	150	°C

Note 1: Ensure that the supply voltage never exceeds 6.0 V.

Note 2: Power dissipation must be calculated with subtraction of TBD mW/°C from maximum rating with every 1°C if T_{opr} is upper 25°C. (on PCB)

Recommended Operating Condition (Ta = −40 to 85°C if without notice)

Characteristics	Symbol	Tes Circuit	Test Condition	Min	Typ.	Max	Unit
Power supply voltage	VIN	—		2.8	—	5.5	V
LED current	I_F	—	VIN = 3.6 V, RSENS = 15 Ω 7 white LEDs, Ta = 25°C	—	20	—	mA

Electrical Characteristics (Ta = 25°C, VIN = 2.8 to 5.5 V if without notice)

Characteristics	Symbol	Tes Circuit	Test Condition	Min	Typ.	Max	Unit
Power supply voltage	VIN	—		2.8	—	5.5	V
Operating consumption current	$I_{IN\ (ON)}$	1	VIN = 3.6 V, RSENS = 15 Ω	—	0.6	0.9	mA
Quiescent consumption current	$I_{IN\ (OFF)}$	2	VIN = 3.6 V, $V_{\overline{SHDN}}$ = 0 V	—	0.5	1.0	μA
$\overline{SHDN}$ terminal "H" level input voltage	$V_{\overline{SHDN}H}$	3	—	1.3	—	VIN	V
$\overline{SHDN}$ terminal "L" level input voltage	$V_{\overline{SHDN}L}$	3	—	0	—	0.4	V
$\overline{SHDN}$ terminal current	I_ $\overline{SHDN}$	4	VIN = 3.6 V, $V_{\overline{SHDN}}$ = 3.6 V or 0 V	—	0	1.0	μA
Integrated MOS-T_r switching frequency	f_{OSC}	5	VIN = 3.6 V, $V_{\overline{SHDN}}$ = 3.6 V	0.77	1.0	1.43	MHz
Switching terminal leak current	I_{oz} (SW)	6	—	—	0.5	1	μA
FB terminal feedback voltage	V_{FB}	7	VIN = 3.6 V, RSENS = 15 Ω Ta = 25°C, L = 22 μH	285	300	315	mV
		7	VIN = 4.2 V, RSENS = 150 Ω Ta = 25°C, L = 22 μH	285	300	315	mV
FB terminal line regulation	ΔV_{FB}	7	VIN = 3.6 V (typ.) VIN = 3.0 to 5.0 V	−5	—	5	%
FB terminal current	I_{FB}	8	VIN = 3.6 V, $V_{\overline{SHDN}}$ = 3.6 V, V_{FB} = 300 mV	—	0.02	—	μA
OVD terminal detect voltage	V_{OVD}	9	—	34.5	37	39.5	V
OVD terminal leakage current	I_{OVD}	10	V_{OVD} = 30 V	—	0.5	1	μA

Usage Precautions

Protection in LED Opened Condition

The operation with OVD terminal is available for the protection in case LED circuit opened.

When the voltage of OVD terminal is over 37 V (typ.), Nch MOS switching operation is disabled in the IC. When the voltage of OVD terminal drops below 37 V (typ.), Nch MOS switching operation becomes available again.

If load of LED is detached, Nch MOS switching operation is disabled with detection of boost circuit voltage and the IC is protected from unexpected over voltage.

Setting of Capacitor

The recommended values are

$C_1 = 2.2$ (μF) or more, $C_2 = 1.0$ (μF) or more

The capacitor of ceramic condenser tends to decrease when voltage is applied.

So, please select the appropriate capacitor in consideration of IC characteristics of withstand voltage and size.

Setting of I_F

Resistance connects between RSENS pin and GND.

The average current is set by this RSENS value and average current are obtained by the following equation.

$$I_F\ (\text{mA}) = \frac{300\,[\text{mV}]}{\text{RSENS}\,[\Omega]}$$

Current value error is within ±5%.

Setting of External Inductor Size

Please select the inductor size with referring this table corresponding to each number of LEDs.

[Recommended inductor values]

LEDs	Indictor Size	Note
2 to 5	10 μH	LED current I_F = 20 mA
Over 6	22 μH	

Current Dimming Control

Recommended brightness control circuits are 4 types.

(1) Input PWM signal to $\overline{\text{SHDN}}$ terminal
I_F can be adjusted with PWM signal by inputting it to $\overline{\text{SHDN}}$ terminal.

<<PWM signal frequency>>

- The recommended PWM signal frequency is from 100 Hz to 10 kHz. There is a possibility to arise the audible frequency in mounting to the board because it is within the auditory area. The greater the oscillation frequency is, the greater the error between the actual value and the theoretical value becomes.

<<Constant number of external condenser>>

- When the PWM signal is off, the time to drain C_2 of charge depends on the constant number. And so, the actual value is little different from the theoretical value.

<<PWM input signal>>

- Set the amplitude of PWM signal within the range of $\overline{\text{SHDN}}$ terminal specification.

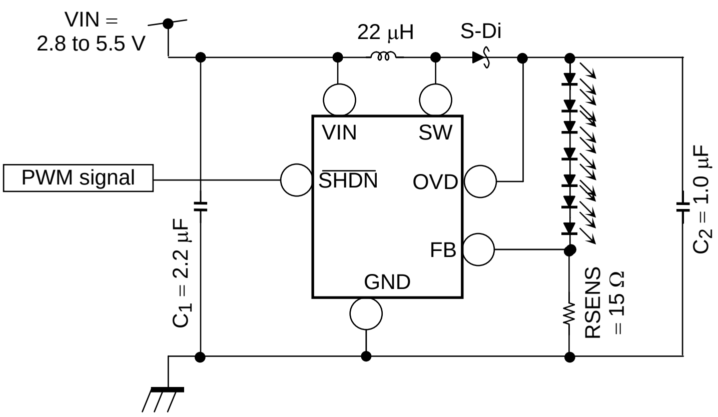
<<Rush current in inputting>>

- In case dimming by inputting the PWM signal to the $\overline{\text{SHDN}}$ terminal, this IC turns on and off repeatedly.
  And the rush current, which provides the charge to C_2, arises in turning on. Take care in selecting the condenser.

<<Current value in control with PWM: Ideal equation>>

$$I_F\,[\text{mA}] = \frac{300\,[\text{mV}] \times \text{ON Duty}\,[\%]}{\text{RSENS}\,[\Omega]}$$

<<Recommended application>>



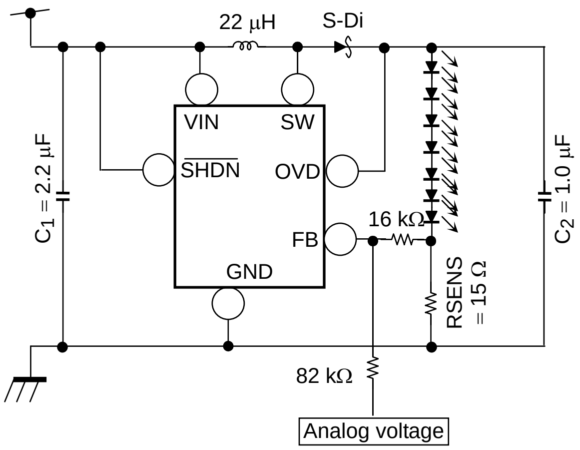
(2) Input analog voltage to FB terminal

I_F can be adjusted with analog voltage input to FB terminal.
This method is without repeating IC ON/OFF, and no need to consider holding rash current.

[Notice]

- LED current value goes over 100% of the current set with RSENS, if the input analog voltage is between 0 V to 300 mV (typ.).

<<Recommended application>>



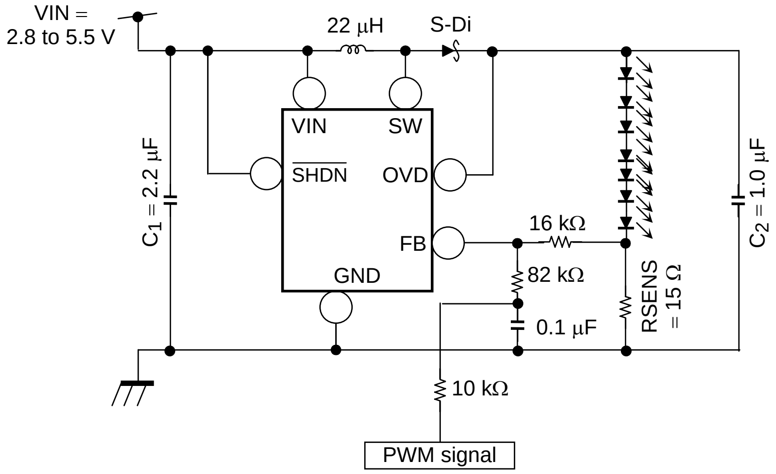
(3) Input PWM signal with filtering to FB terminal

I_F can be adjusted with filtering PWM signal using RC filter indicated in recommended circuit, because the PWM signal can be regard as analog voltage after filtering.
This method is without repeating IC ON/OFF, and no need to consider holding rash current.

[Notice]

- LED current value goes over 100% of the current set with RSENS, if the input voltage after filtering is between 0 V to 300 mV (typ.).

<<Recommended application>>



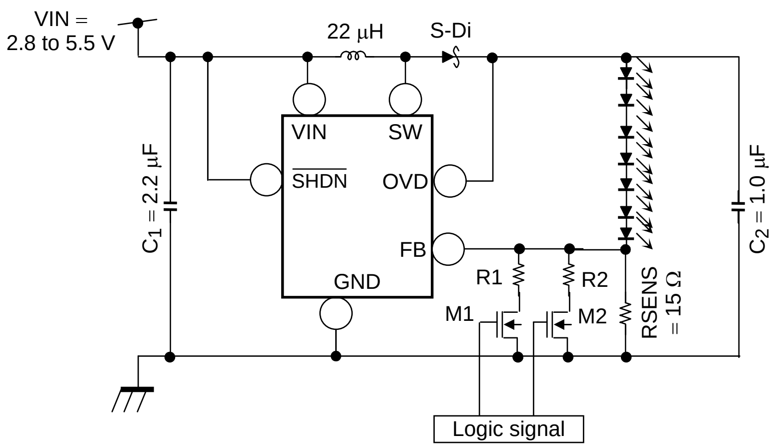
(4) Input logic signal

I_F can be adjusted with logic signal input as indicated in recommended circuit.
The resistor connected the ON-State Nch MOS drain and RSENS determines IF.

Average of setting current I_O (mA) is next, approximately.

$$I_F\ [\mathrm{mA}] = \frac{300\ [\mathrm{mV}]}{\text{Sum of resistor value}\ [\Omega]}$$

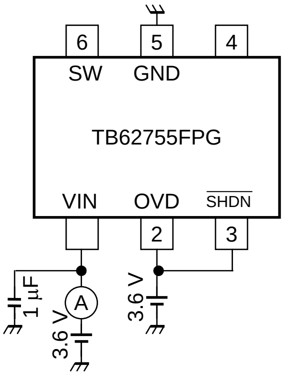
<<Recommended application>>



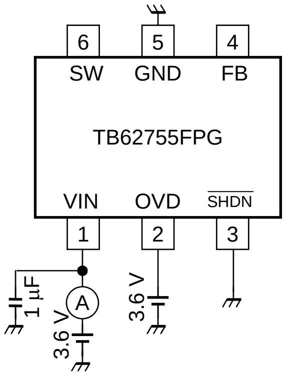
M1	M2	LED Current
OFF	OFF	$\frac{300\ [\mathrm{mV}]}{\mathrm{RSENS}\ [\Omega]}$
ON	OFF	$300\ [\mathrm{mV}] \times \frac{\mathrm{RSENS}\ [\Omega] + \mathrm{R1}\ [\Omega]}{\mathrm{RSENS}\ [\Omega] \times \mathrm{R1}\ [\Omega]}$
OFF	ON	$300\ [\mathrm{mV}] \times \frac{\mathrm{RSENS}\ [\Omega] + \mathrm{R2}\ [\Omega]}{\mathrm{RSENS}\ [\Omega] \times \mathrm{R2}\ [\Omega]}$
ON	ON	$300\ [\mathrm{mV}] \times \frac{\mathrm{RSENS}[\Omega] \times \mathrm{R1}[\Omega] + \mathrm{RSENS}[\Omega] \times \mathrm{R2}\ [\Omega] + \mathrm{R1}[\Omega] \times \mathrm{R2}\ [\Omega]}{\mathrm{RSENS}[\Omega] \times \mathrm{R1}[\Omega] \times \mathrm{R2}\ [\Omega]}$

TEST Circuit

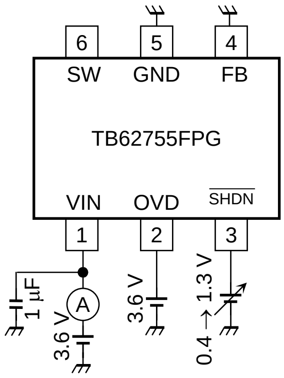
1. I_{IN} (ON)



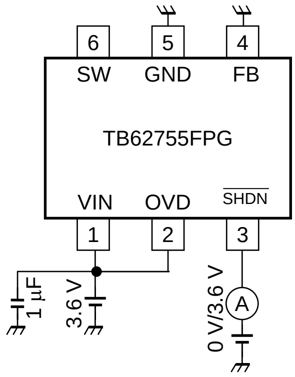
2. I_{IN} (OFF)



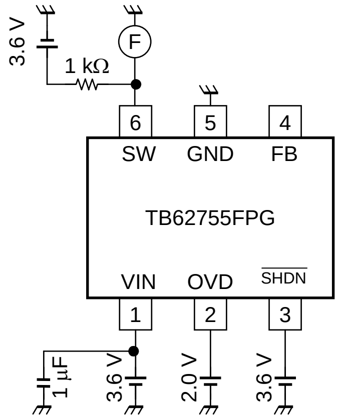
3. $V_{\overline{SHDN}H}$, $V_{\overline{SHDN}L}$



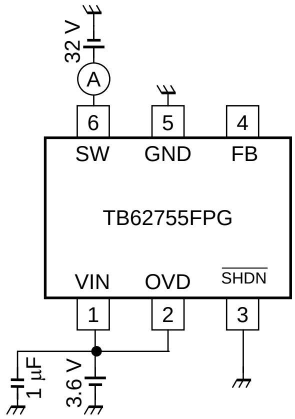
4. $I_{\overline{SHDN}}$



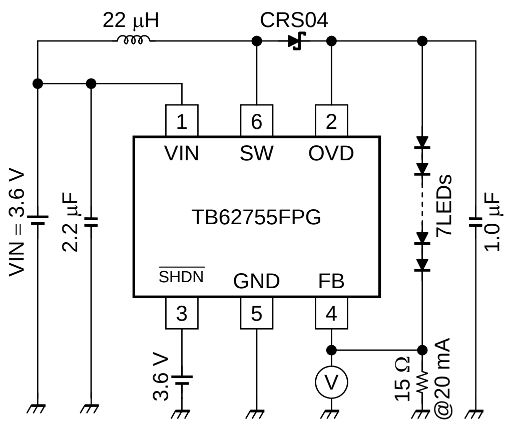
5. f_{OSC}



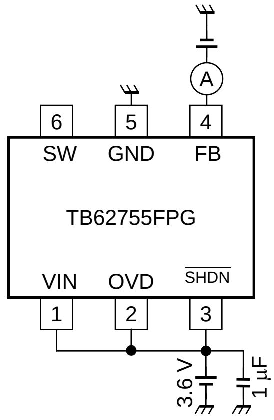
6. I_{OZ} (SW)



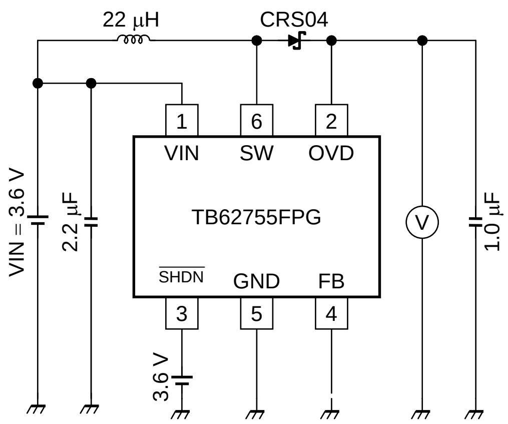
7. V_{FB}, ΔV_{FB} *1



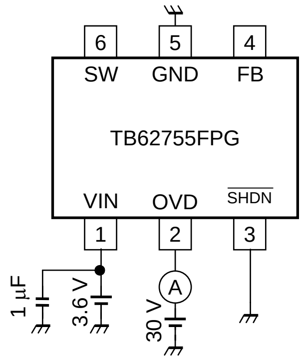
8. I_{FB}



9. V_{OVD} *1

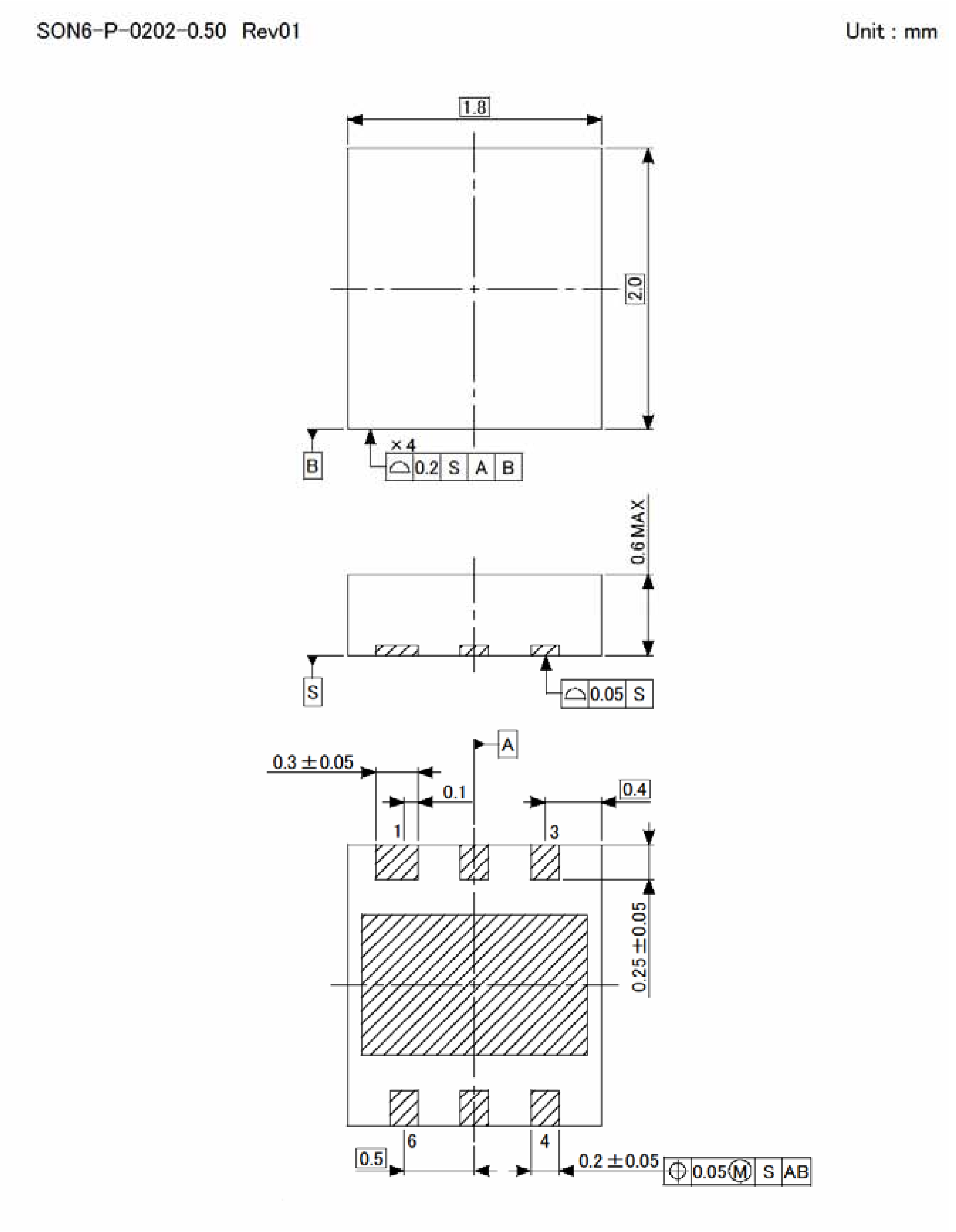


10. I_{OVD}



*1: The locations of the pins differ from the actual ones to simplify the diagram. See page 1 for the actual pin locations.

Package Dimensions



Weight: 0.005g (typ.)

Notes on Contents

1. Block Diagrams

Some of the functional blocks, circuits, or constants in the block diagram may be omitted or simplified for explanatory purposes.

2. Equivalent Circuits

The equivalent circuit diagrams may be simplified or some parts of them may be omitted for explanatory purposes.

3. Timing Charts

Timing charts may be simplified for explanatory purposes.

4. Application Circuits

The application circuits shown in this document are provided for reference purposes only. Thorough evaluation is required, especially at the mass production design stage.
Toshiba does not grant any license to any industrial property rights by providing these examples of application circuits.

5. Test Circuits

Components in the test circuits are used only to obtain and confirm the device characteristics. These components and circuits are not guaranteed to prevent malfunction or failure from occurring in the application equipment.

IC Usage Considerations

Notes on Handling of ICs

(1) The absolute maximum ratings of a semiconductor device are a set of ratings that must not be exceeded, even for a moment. Do not exceed any of these ratings.
Exceeding the rating(s) may cause the device breakdown, damage or deterioration, and may result injury by explosion or combustion.

(2) Use an appropriate power supply fuse to ensure that a large current does not continuously flow in case of over current and/or IC failure. The IC will fully break down when used under conditions that exceed its absolute maximum ratings, when the wiring is routed improperly or when an abnormal pulse noise occurs from the wiring or load, causing a large current to continuously flow and the breakdown can lead smoke or ignition. To minimize the effects of the flow of a large current in case of breakdown, appropriate settings, such as fuse capacity, fusing time and insertion circuit location, are required.。

(3) If your design includes an inductive load such as a motor coil, incorporate a protection circuit into the design to prevent device malfunction or breakdown caused by the current resulting from the inrush current at power ON or the negative current resulting from the back electromotive force at power OFF. IC breakdown may cause injury, smoke or ignition.
Use a stable power supply with ICs with built-in protection functions. If the power supply is unstable, the protection function may not operate, causing IC breakdown. IC breakdown may cause injury, smoke or ignition.

(4) Do not insert devices in the wrong orientation or incorrectly.
Make sure that the positive and negative terminals of power supplies are connected properly.
Otherwise, the current or power consumption may exceed the absolute maximum rating, and exceeding the rating(s) may cause the device breakdown, damage or deterioration, and may result injury by explosion or combustion.
In addition, do not use any device that is applied the current with inserting in the wrong orientation or incorrectly even just one time.

(5) Carefully select external components (such as inputs and negative feedback capacitors) and load components (such as speakers), for example, power amp and regulator.
If there is a large amount of leakage current such as input or negative feedback condenser, the IC output DC voltage will increase. If this output voltage is connected to a speaker with low input withstand voltage, overcurrent or IC failure can cause smoke or ignition. (The over current can cause smoke or ignition from the IC itself.) In particular, please pay attention when using a Bridge Tied Load (BTL) connection type IC that inputs output DC voltage to a speaker directly.

Points to remember on handling of ICs

(1) Thermal Shutdown Circuit
Thermal shutdown circuits do not necessarily protect ICs under all circumstances. If the thermal shutdown circuits operate against the over temperature, clear the heat generation status immediately. Depending on the method of use and usage conditions, such as exceeding absolute maximum ratings can cause the thermal shutdown circuit to not operate properly or IC breakdown before operation.

(2) Heat Radiation Design
In using an IC with large current flow such as power amp, regulator or driver, please design the device so that heat is appropriately radiated, not to exceed the specified junction temperature (T_J) at any time and condition. These ICs generate heat even during normal use. An inadequate IC heat radiation design can lead to decrease in IC life, deterioration of IC characteristics or IC breakdown. In addition, please design the device taking into considerate the effect of IC heat radiation with peripheral components.

(3) Back-EMF
When a motor rotates in the reverse direction, stops or slows down abruptly, a current flow back to the motor's power supply due to the effect of back-EMF. If the current sink capability of the power supply is small, the device's motor power supply and output pins might be exposed to conditions beyond maximum ratings. To avoid this problem, take the effect of back-EMF into consideration in system design.

About solderability, following conditions were confirmed

- Solderability

(1) Use of Sn-37Pb solder Bath
- solder bath temperature = 230°C
- dipping time = 5 seconds
- the number of times = once
- use of R-type flux

(2) Use of Sn-3.0Ag-0.5Cu solder Bath
- solder bath temperature = 245°C
- dipping time = 5 seconds
- the number of times = once
- use of R-type flux